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Petrochemical Industry Polypropylene Plant

Process Gas Chromatograph Application Note

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In addition to polyethylene, one of the most common plastics is polypropylene. The relatively high melting point of polypropylene makes it a good material for the medical industry since it can withstand the heat of sterilization. The stiffness qualities of polypropylene make it an ideal polymer to make synthetic fibers (carpets), injection molded items (toys), and blow molded items (squeezed bottles).

As with other polymers, polypropylene is often a mixture of propylene plus a second compound called a comonomer. The actual chemical used for the comonomer varies depending on the desired properties, but can range from a simple chemical like ethylene to more complex butenes and hexenes. A number of polypropylene plant designs are available in the industry. The example given here is a two stage slurry reactor design.

Polymer-grade propylene enters the first reactor along with diluents, hydrogen, and catalyst. The reaction components are continuously fed into the first reactor. Hydrogen is added to control the size of the polymer molecule and sets the overall melting point of the final product. To keep everything as a slurry, an inert diluent compound such as hexane or butane is added. The diluent also helps absorb the heat that is generated in the reaction.

The mixture leaves the first reactor, and recycled comonomer is added to the stream. It then enters the second reactor where fresh propylene and comonomer are added to finish the reaction process. The finished polymer leaves the second reactor, along with the diluent and unreacted components, and enters a flash tank. Due to the flash tank's lower pressure, the unreacted monomers and the diluent vaporize and exit the top of the vessel. The polymer settles out of the bottom to be extruded into plastic sheets or pellets.

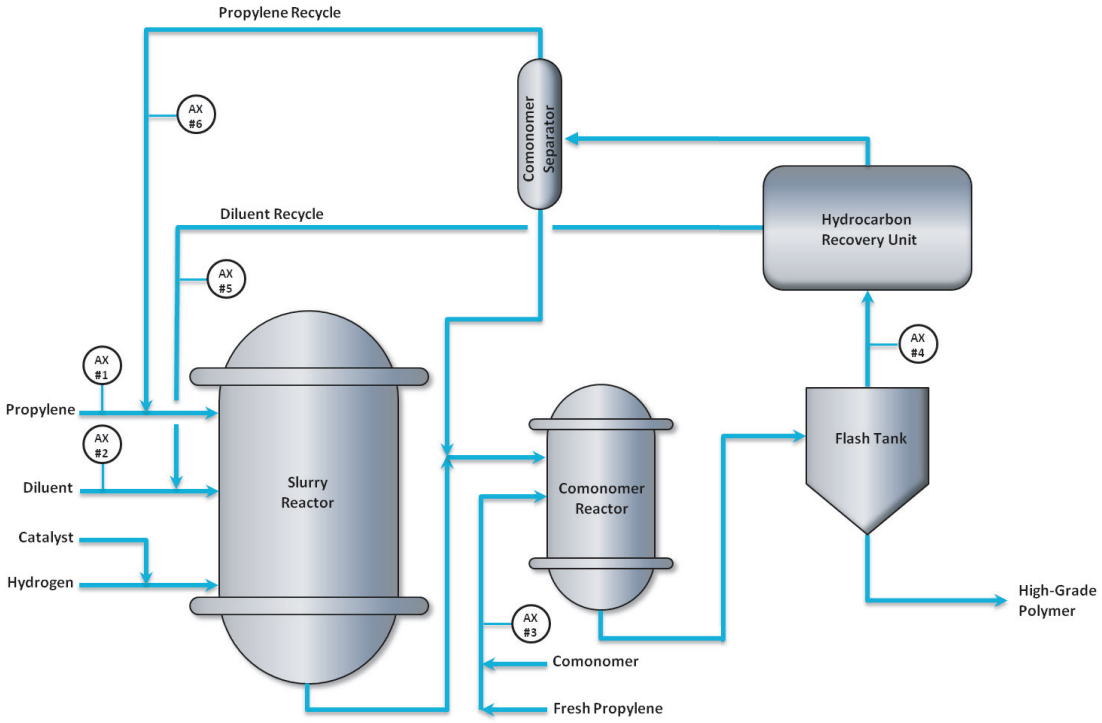
The vapors leaving the top of the flash tank enter a diluent recovery system to separate the diluent from unreacted monomers as well as to filter out polymer dust that might have carried over. The diluent recycles back to the feed of the reactor. The unreacted propylene and comonomer enter a stripper where they are separated from each other. The propylene recycles to the feed of the first reactor and the comonomer recycles to the feed of the second reactor.

Typical GC Measurements

A variety of process gas chromatograph measurements are made to provide the compositional data needed for optimum plant operation:

1. **Propylene Feed** – monitors the propylene purity of the feed to the slurry reactor.
2. **Diluent Feed** – monitors the diluents for hydrocarbon impurities that are fed to the slurry reactor.
3. **Comonomer Reactor Feed** – ensures the fresh propylene to comonomer ratio is set for maximum efficiency as well as monitors for impurities in the feed to the comonomer reactor.
4. **Flash Tank Off-Gas** – measures the off-gas for the concentrations of the unreacted compounds to help control the severity of the reactions occurring in the reactor. The measurement can be difficult due to the presence of large amounts of polymer dust. Special sample probes are used to filter out the polymer dust using self-cleaning filter designs.
5. **Diluent Recycle** - monitors the diluents recycle stream for hydrocarbon impurities.
6. **Propylene Recycle** – monitors the propylene recycle stream for hydrogen and comonomer impurities

Polypropylene Plant



Analyzer No.	Stream	Components Measured	Measurement Objective
1	Propylene Feed	CO_2, C_2, C_3, MA, PD	Monitors the impurities in the propylene feed stream
2	Diluent Feed	Hydrocarbon impurities	Monitors the impurities in the diluent feed stream
3	Comonomer Reactor Feed	CO_2, C_2, C_3	Monitors the impurities in the comonomer reactor feed stream
4	Flash Tank Off-Gas	H_2, $C_3^=$, Comonomer	Provides feedback on reaction severity
5	Diluent Recycle	Hydrocarbon impurities	Monitors the impurities in the recycled diluent stream
6	Propylene Recycle	CO_2, C_2, C_3	Monitors the impurities of the recycled propylene stream

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